publications, and he may do something toward getting scientific truth into it.

May I also add just a word on political science?

It is one of the calamities of democracy that most economic and social problems are first worked out by experts, who embalm their results in books which are interred in university libraries, and are then, long after, worked out by rule of thumb, by practical politicians and business men. One of the supreme problems of our universities is to bridge this gap.

Of the popular scientific magazines, I scarcely need speak. You know them better than I do. But do they need to appeal so nearly exclusively to the mechanical curiosity of boys? Some magazines, like *Good Housekeeping,* are doing excellent work in popularizing dietetic science among women. Is there not some way to penetrate the indurated intellects and the atrophied imaginations of our adult men, also?

I realize that I have added little to your knowledge of any subject, by these desultory remarks. May I hope, however, to have aroused at least a little unscientific curiosity?

Chester H. Rowell

EMIL FISCHER

The news has just reached us that Emil Fischer is no more. Since the fateful August, 1914, Germany has lost her Ehrlich, her Buchner, and her Baeyer; England, her Ramsay, Crookes and Moseley. Deaths occur, wars or no wars; yet Buchner might have lived had not a shell cut short his existence; and young Moseley had barely started along his brilliant career when he, like the promising Rupert Brooke, laid down his life for his beloved England. Ramsay's end, we know, was hastened by manifold war duties. To what extent Fischer was a victim of the war is still unknown to us; but we were told, from time to time, of his violent pan-Germanism, doubtless encouraged by the exalted position he held under the crown. The magnitude of Germany's *débâcle* would have crushed a spirit less proud than *Geheimer-Regierungsrat* Fischer.

What ever opinions we may have regarding Fischer's political affiliations there can be no question of his position in the history of chemistry. His bitterest enemies are the first to pay tribute. He easily takes his place among the greatest organic chemists of our generation.

To appreciate his work a little more we must look into the state of the science when Fischer began his labors.

That animal and vegetable life were largely made up of carbon compounds, that the food we eat could be largely divided into fat, proteins and carbohydrates —all this was known. If, then, a knowledge of the composition of these substances, as truly belonging to organic chemistry as marsh gas or benzene, was vague and wholly unsatisfactory, this was due to the complexity of their make-up. Chevreul and Berthollet had largely cleared the situation in so far as the fats were concerned, but the chemistry of the carbohydrates, and particularly that of the proteins, remained as mysterious as ever. The three foodstuffs were the borderland where chemistry ended and biology began; the lack of a solution of the composition of at least two of these foodstuffs left the finishing touches of the edifice of organic chemistry still undone, and gave a wholly unsatisfactory foundation for the science of physiology.

To the solution of this problem Fischer pledged his life while still a student, and brilliantly did he fulfil his life's task. With an imagination tempered only by a splendid scientific training, an originality of mind which made a lasting impress upon every piece of work with which he was associated, and a rare skill in devising apparatus, he, first by his own labors, and

later, as director-general of an army of aspiring students, gradually unfolded the mysteries that had enshrined the most complex chemical substances known to man. Like all great contributions, his had added not only to our chemical knowledge but has shed a flood of light on cognate sciences, such as botany, zoology and physiology.

Fischer was born in Euskirchen, Rhenish Prussia, on October 9, 1852. His father, Lorenz Fischer, was a successful merchant whose success in business must have made a deep impression upon his son, for Emil, after matriculating the gymnasium in Bonn, joined his father's concern at the age of seventeen.

This enthusiasm for the commercial world, however, was short lived. Within two years he had abandoned all thoughts of high finance, and had inscribed himself as a student at Bonn University. Kekulé, one of Van't Hoff's teachers, was the professor of chemistry, and Engelbach and Zincke were his active assistants. Fischer came in contact with all three.

The ill-omened Franco-German war had barely terminated when the German government decided to found a university at Strassburg. To this place, in the autumn of 1872, Fischer, true to the German student's traditions, came to spend part of his *Wanderjahre*.

By the end of a year Fischer was ready for the next step in the training of a chemist—a course in organic chemistry. This brought him in contact with Adolf von Baeyer, the professor of the subject.

Fischer immediately came under the spell of Baeyer. The professor was rapidly reaching the height of his intellectual output. His amazing mastery of every phase of the subject, the keen criticism to which every piece of work was subjected, the fertility of his ideas, combined with the fatherly care he took of his "children," the students, made Baeyer very popular with his assistants and research workers, not least of all with Fischer.

In July, 1874, Fischer completed an investigation on the coloring matters fluorescein and orcin-phthalein, for which he received his Ph.D. His immediate appointment to an assistantship was evidence that he had already made an impression upon Baeyer, whose faculty for detecting promising material was not the least of his gifts.

In less than a year Fischer, with his discovery of phenylhydrazine, forged to the very front rank of organic chemists. Later this substance in his hands proved the most effective tool in synthesizing the sugars, which are the typical members of the carbohydrate family. To-day the *osazone* test for sugars, a test depending upon the use of this same phenylhydrazine, is among the commonest and the most effective methods used by the chemist, the physiologist, and the clinician for the isolation and detection of the sugars.

Little wonder, then, that when Baeyer in this same year was selected to succeed Liebig, in Munich, he was desirous that young Fischer should accompany him. This, of course, was just what Fischer wanted.

For the next three years Fischer held no official position at the University of Munich. As events proved this was the most fortunate thing that could have happened.

With phenylhydrazine as the starting point, the various derivatives of this parent substance were investigated, and its relationship to the *diazo* compounds was clearly established. The ease with which the phenylhydrazine combines with other substances gave rise to an almost endless series of new compounds. To us of par-

ticular interest is its combination with two important classes of organic compounds known as the *aldehydes* and *ketones*—a discovery which found direct application in the chemistry of the sugars.

At the same time, Fischer, in collaboration with his cousin, Otto Fischer, began an investigation of the rosaniline dyestuffs —the magenta of Perkin—which terminated in the brilliant discovery that these dyes were all derivatives of a base *triphenylmethane.*

Fischer was made *privat-docent* in 1878 and at the end of the year was promoted to the extraordinary professorship and given entire charge of the analytical department in Baeyer's laboratory.

Then began those classical investigations into the active constituents of coffee and tea, caffeine and theobromine, and their relationship to xanthine and guanine—decomposition products obtained from the protein in the nucleus of cells—which ultimately opened up an entirely new chapter in plant and animal chemistry.

In the Easter of 1882 Fischer accepted a call as full professor (*ordinarius*) to Erlangen, and three years later be exchanged this chair for one in Würzburg.

After many weary trials, Fischer managed to synthesize the most important sugars—among them fruit and grape sugar —and also to prepare many new ones artificially. It was in the course of this intricate and laborious work that he had occasion to put Van't Hoff and Le Bel's theory of the asymmetric carbon atom to exhaustive tests, with results which established the theory more firmly than ever.

It was also during these epoch-making experiments on the sugars, when phenylhydrazine found constant application, that Fischer began to suffer with chronic poisoning, due to the inhalation of the vapors of this substance. Its effects he never got rid of, and from then on he was more or less of a semi-invalid. This might perhaps explain why in after years students found him somewhat of a "grouch" and quite unapproachable. The testimony of some of his students at Würzburg seems to bear conclusive witness to the fact that in those days, at least, he was not only an inspiring leader and lecturer, but took a very active interest in his research men.

The appointment to a full professorship made feasible his marriage to the lady he had long courted, *Fräulein* Agnes Gerlach. The two made a striking pair. Both were tall and handsome, with intellect and wit aplenty. Their son has faithfully followed in his father's footsteps.

In 1892 came the crowning event of his career. A. W. Hoffmann, who had been professor at the Royal School of Chemistry in London for some years, and had there taught such men as Crookes and Perkin, and had later been appointed to the chair of chemistry at Berlin University, died, and Fischer was selected to succeed him.

In Berlin Fischer continued his work on the sugars. The fact that many of these bring about fermentation led Fischer to fruitful studies on the possible constitution of ferments and their relationship to the substances they act upon.

Fischer's synthetic work in the sugar series, particularly his studies into the configuration of cane sugar, maltose and lactose received a great impetus from the success which attended his efforts in preparing glucosides—combinations of glucose and one or more other substances—artificially. By the study of emulsin and other enzymes in yeast on such glucosides, Fischer found that the slightest change in the configuration of the glucoside inhibited the action of the enzyme. Zymase, another enzyme in yeast, which is directly responsible for the conversion of glucose into alcohol, behaved

similarly. This led him to the conclusion that a close chemical relationship exists between the enzyme and the substance on which it acts—a view which led to his famous analogy of the lock and key relationship. Just as one key fits one lock, so any one enzyme will act on only a certain type of substance.

In the winter of 1894 Fischer resumed his earlier work on uric acid and caffeine. After three years he succeeded in synthetically producing every constituent of the group, and traced them all to a mother substance to which he gave the name of *purin* (a word suggested by the phrase *purum uricum*).

The chemist, the physiologist and the pathologist can but wonder at such genius. Here are the most complex and the most important class of protein bodies, the so-called nucleoproteins, which, as their name implies, are found in the nucleus of the cell, and which, in the course of their decomposition in the body, give rise to *xanthine, hypoxanthine, adanine, guanine, etc.*—all typical purines. Here are these purines which, in their further travels in the body, come to the liver, where a larger percentage of them are oxidized to uric acid—another member of the purine family. This same uric acid is a never-failing constituent of the urine, and its quantity gives valuable data regarding nucleoprotein metabolism in the body. This becomes of paramount importance in such a disease as gout. The inter-relationship of these complex purines, as well as their relationship to plant analogues, such as caffeine and theobromine, have been as thoroughly probed by Fischer as the composition of water or that of air. He has gone even further. Having found relationships, and having traced the substances to one mother substance, he has succeeded in building them all up from this mother substance—a piece of work which with but one exception, has no equal in synthetic chemistry.

The one exception is Fischer's crowning series of researches on the proteins. No work approaching this had ever been done before.

Fischer was not the first to tackle this problem of problems, but he was the first to give the lead in the right direction.

The crude physical methods of classifying proteins have pointed to the fact that there are some forty to fifty in number. All of these, when hydrolyzed, give a large percentage of the nineteen amino-acids which are common to most proteins; the differences among proteins is most marked in the amount of the various amino-acids which they yield when hydrolyzed.

Due in no small part to the labors of Fischer and his co-workers most of these nineteen amino acids have been synthesized from simpler bodies.

If the hydrolysis of proteins, and the careful investigation of the decomposition products so produced was a difficult task, what are we to say of the reverse process, whereby, by starting with amino-acids, we build up proteins? Yet that is what Fischer did. He succeeded in working out methods by which amino-acids could be chemically joined on to one another in some such way as the links of a chain. He has given the name *polypeptids* to such combinations of amino-acids.

In his most celebrated experiment in the synthesis of proteins, Fischer succeeded in combining eighteen amino-acids—an octadecapeptide—which is the most complicated artificial substance that has ever been produced, and which shows some very striking resemblances to the natural proteins, not the least of which is the way trypsin, the pancreatic enzyme, breaks it up into the amino-acids out of which the artificial protein was built.

The starting materials for this synthesis cost $250, "so that," says Fischer, "it has not yet made its appearance on the dining table!"

These glorious researches were still in full blast in 1902 when Fischer was awarded the Nobel prize in chemistry.

There seems to be some foundation for the fact that the opening up of our Rockefeller Institute in New York City gave German scientists some very unpleasant moments. They were afraid that an institute, devoted entirely to research, and manned by talent second to none, would soon outstrip any university, where of necessity teaching, aside from research, required much attention. This led Ostwald, Nernst and Fischer to start an agitation for the endowment of some similar institute in Germany, with the result that the research institute in Berlin-Dahlem was founded.

Fischer's researches into the carbohydrates, purines and proteins, is of such enormous importance that, at the repeated requests of the scientific public, they were published in book form in three bulky volumes, the first, "*Untersuchungen über Amino-Sauren, Polypeptide und Proteine*" (1899–1906), dealing with the proteins, the second, "*Untersuchungen in der Purin Gruppe*" (1882–1906), with the purines, and the third "*Untersuchungen über Kohlenhydrate und Fermente*" (1884–1908), with the carbohydrates and enzymes. It is certain that in organic chemistry no three volumes of such far-reaching influence have ever before been published.

Fischer's most recent work dealt much with the tannins, substances that play an important part in leather manufacture.

Fischer's work, his influence as teacher and inspirer of men, raised the Berlin Chemical Laboratory to the first position among the chemical laboratories of the world. His fame attracted students from every quarter of the globe, and these flocked in such numbers to him that they soon counted in the hundreds, and special *privat-docenten* had to be appointed to take care of them. It thus came about that many of the men who had gone to Berlin to work under Fischer in reality worked under some of Fischer's *privat-docenten,* and, outside of the lectures, probably did not see Fischer himself more than two or three times during their three or four years in the German capital. At one time or another H. Gideon Wells, that excellent pathologist of Chicago University, T. B. Osborne, of the Connecticut Experiment Station, and the foremost authority on vegetable proteins, and P. A. Levene and W. A. Jacobs, the well-known physiological chemists of the Rockefeller Institute, were his students. Of his many pupils Fischer considered Emil Abderhalden, now the professor of physiology at Halle University, a Swiss by birth, the most gifted.

Fischer's death is an irreparable loss to science. He is so much of our generation that one hesitates to use superlatives, but one is sorely tempted to speak of him as the greatest organic chemist of all times.

Benjamin Harrow
Columbia University

SCIENTIFIC EVENTS

DESTRUCTION OF ELEPHANTS IN CAPE COLONY

A special correspondent of the London *Times* writes that the provincial council of the Province of the Cape of Good Hope has passed a decree authorizing the destruction of the herd of elephants in the Addo Bush Forest Reserve. Unless this Union government take action promptly, this hitherto carefully-preserved remnant of a species that once ranged all over South Africa will be utterly destroyed. The last elephant in Zululand, an old male, was recently killed. The elephants of South-